**Message to NASA Team Upon the Occassion of NASA's 40th Anniversary**

**(Includes revised remarks)**

**Daniel S. Goldin**

**Administrator**

**National Aeronautics and Space Administration**

**October 1, 1998**

When President Eisenhower and the Congress established NASA, they did so with the boldest and most noble of missions: to pioneer the future. We were told to explore new frontiers and enhance life here on Earth. We were asked to instruct; we were expected to inspire. Forty years later, thanks to an American public with an unquenchable thirst for knowledge and a relentless sense of adventure, the NASA Team has delivered.

Think about this: Forty years ago, jet passenger service was a novelty. Global communications meant a telephone line laid across the bottom of the Atlantic Ocean. When NASA was first getting started, the only way to track hurricanes was to fly planes directly over and into the storms. Our universe -- even the cosmic neighborhood just above our atmosphere -- was a mystery. In 1958, sending humans to the moon was pure science fiction.

But we dared to dream. We imagined what could be possible. And then along with our partners in industry and academia, NASA went to work.

In 1998, hundreds of millions of people ride American jets each year and new designs for flight go higher, faster and farther than ever before. Global space communications have helped create a global community. Weather satellites can track phenomena, like an El Niño condition, months in advance. There are still many mysteries to be solved, but Voyager, Galileo, the Hubble Space Telescope and other planetary and astronomy missions have circled neighboring planets, giving us our first view of black holes, and begun to peer back at the very beginning of our universe. A space program that is forty years old has sent humans to the Moon, robots to Mars, spacecraft to the furthest reaches of our solar system, and soon will help lead construction of the International Space Station. And for every step we take out there, we have contributed to a better quality of life right here. That is true whether it be one of thousands of "spin-off" technologies that has produced new products and services such as medical devices to detect breast cancer earlier. That is true when a child who looks up and knows that no longer is the sky the limit; it is the stars and beyond.

NASA has had a great forty years, but what the American people can be most proud of is this: when it comes to pioneering the future, we are just getting started. What will always define this aeronautics and space program -- and this country -- is our firm belief that there will forever be something to be invented, somewhere to be discovered, someplace to be visited. Rest assured, NASA will do its best in the next forty years to find out just what and where that will be.

At a recent Congressional hearing, I was invited to address NASA's strategic goals for the next 40 years. It's hard to pass up an opportunity to extend our reach beyond the near-term challenges that consume most of us and take time to ponder a future we may chose to create. As part of our celebration this afternoon, I'd like to share with you the vision I presented at that hearing.

Keep in mind, I will be describing goals based on a vision that I believe is achievable in the long-term. This vision is not necessarily built on an mission profile that has been proposed through the traditional five-year budgetary process and debate.

Allow me to fuel your imaginations by describing a vision that I believe the NASA Team will be hard at work on three or four decades from now. If we are able to align four critical factors that include scientific and technical opportunities, a political imperative, national economic impact, and national spirit, I believe this vision can become reality.

It starts 25 years from now with a commercial flight from Tokyo to a commercial spaceport near the Kennedy Space Center. Thanks to revolutionary breakthroughs in advanced materials and coatings, distributed intelligence and control systems, and advanced lightweight structural concepts integrated with the next generation of air-breathing jets and rockets, the flight was completed in a little more than two hours. Not bad!

Because of a thick fog, there is practically zero visibility at the spaceport. But that is not the concern that it was back in 1998. Now, high definition synthetic vision allows the pilot to clearly see through even the heaviest of fog, or snow, or dust. It allows the pilot to see better at night, as well. The vehicle also has an advanced crew interface. We have been able to couple humans and computers using natural, high order language to maximize performance.

The pilot doesn't control the vehicle with buttons, keyboards, and a joystick. Instead, the computer interface is an intelligent interchange with total immersion in sight, sound and touch. The computer is aided by waves from the pilot's brain. It monitors brain waves to determine -- and even alert the pilot -- when their attention might be lapsing.

For the entire two hour trip from Japan to Florida, the pilot has full situational awareness of the vehicle's state of health and the surroundings. Remote sensing satellites send signals directly to the vehicle and gives the pilot real-time knowledge about weather and terrain. GPS navigation systems, also readily accessible by the pilot, give the precise position. Communication links and onboard sensors determine where other vehicles and obstacles are, and an onboard computer database tells the pilot and crew where the other vehicles, obstacles and micro-disturbances in the atmosphere will be.

Together, this gives the pilot real-time, on-board, unprecedented air-traffic control. And all of this has made the flight safer and faster than ever before. This flight used to take 17 hours, not two, and the heavy fog would have had the plane circling or looking for another airport to land. But not today. And that's important.

It is important because the Japanese Prime Minister is joining members of the Administration and Congress, along with other heads of state, to welcome the return of an international crew returning from space. Deep space.

Their mission has been a great success. The crew just launched an interstellar probe from where

they were stationed for the past few years: An international permanent outpost near Mars. The installation conducts research and operational activities supported by government and private sector investment.

By this time advanced telescopes have imaged countless Earth-like planets beyond our solar system with a resolution high enough to see geological features and biological processes at 600 trillion miles. We've learned so much from watching our own planet as well as studying the other planets in our solar system, especially Mars and Europa, that we can now identity the fingerprints of life. We know there's life on Earth. We will find out if it is ubiquitous to the Universe.

Our space robots and telescopes, along with ground-based telescopes have also provided invaluable information to study comets and asteroids. This information will help us better understand their characteristics and the likelihood of their impact with our planet. Our investigation results have also been shared with other agencies to develop potential planetary protection capabilities should such an object pose a threat to Earth.

So the probe our astronauts launched is going to travel to, remotely sense, and drop a mini robot on one of the planets we've discovered around a near-by star. We think the planet has the right conditions for life.

The remote sensing technology we're using has been working closer to home for years. Around the world, remote sensing has been used to help us with environment, climate, and weather management -- not days in advance, but months and years.

NASA's Earth Science program has been working in partnership with the private sector and other governments locally, regionally, and globally to predict regional rainfall and drought on a seasonal, an inter-annual, and ultimately a multi-decade basis.

Developing countries have been using remote sensing and other technologies to help better manage the precious water resources and agricultural products. For instance, this technology allows people to measure the variability of a specific field and literally "farm by the yard." We know exactly which area needs more irrigation and which area needs less. We know where there is too much fertilizer and what part of the field isn't getting enough. Same with pest control. We know exactly what portions of the field are ready for harvest and what portions are not. Space-based technologies are leading to better yields and a better quality of life.

Ever since 1996, private sector investment in space has far surpassed government expenditure on space activities. In addition to the mature commercial industries related to telecommunications, remote sensing, and launch services, new space-based industries have emerged. The private sector has realized growth associated with Lunar, Martian, and near-Earth asteroid opportunties, such as manufacturing and mining of space resources, energy production and transmission, and tourism.

Two members of the previously mentioned interplanetary crew had started training in 2001 and flew on a vehicle called the Space Shuttle. Experiments were conducted on the Shuttle that used the unique vantage point of space to look back at and monitor the Earth. We've come a long way since then.

Allow me come back to the present for a moment to focus on one of our most critical requirements -- space transportation. After forty years, it should be quite clear that we should never place all our faith in a single launch system. The broad array of research and exploration goals that we want to pursue will go no where unless we have significantly more reliable and affordable transportation capabilities.

It has taken us many years, but we are now in the position where we are able to rely on one launch system while we make progress on an advance capability. At times, this dual approach seems to generate unnecessary competition among our own Team members. Both the Space Shuttle and future reusable launch vehicles are vital to the future of America's space program.

The Shuttle has been an important part of our history since its first launched in 1981, and it continues to be the workhorse for human space research and development. Before it completes its service life all those associated with the Space Shuttle program will have provided more than three decades of distinguished service to the Agency**.** Until a proven replacement is able to be rolled to the launch pad, this is the vehicle that will guarantee human access to low-Earth orbit and play a critical role in the assembly of the International Space Station.

The Shuttle system requires the dedicated attention of hundreds of civil servants and thousands of support contractors for operations and maintenance. The members of the Space Shuttle Team have refined and improved this vital transportation system throughout its operational life. The Shuttle Team has compiled an enviable record of research and operational accomplishments. Additionally, they remain the benchmark for excellence for air and space safety.

After International Space Station is assembled and during its operational phase, it is our intention to gradually transfer the research**,** transportation, and logistics support for low Earth obit operations to the private sector. It is hoped that launch vehicles developed both with and without government support will provide a higher degree of reliability and operability that will provide dramatic reductions in the cost and safety of access to space.

With less money directed toward shuttle operations, NASA will be able to direct more of its scarce resources towards long range research and development activities. Shuttle Team members will be retrained for new cutting edge assignments and no doubt many will seek responsibilities with the growing resuable launch vehicle industry.

Now, let's return to our vision.

Thanks to knowledge gained from our launch systems, the interstellar probe launched by the international crew requires only a few controllers during the entire cruise phase. That's because the probe is a thinking, intelligent, and self-tasking spacecraft. It is too far away for commands to be transmitted from a mission control facility on Earth. At the speed of light, it would take months, even years, to relay the simplest communications. Just think how communications that go tens of trillions of miles will revolutionize communications on Earth that only have to go thousands of miles! And think of how advances in electronic propulsion might assist the emerging space-based power industry!

This spacecraft can also learn and adapt as it travels. It has real-time health monitoring capability because the decisions are being made by the spacecraft itself. It is self-diagnostic and self-repairing. In many ways it is just like the human body. It has sensors and actuators. It reacts to

stimuli. And it has a distributed nervous system with intelligence that enables the spacecraft to react and adjust according to changing environments.

This very same kind of technology is on display in the vehicle that flew from Japan to Florida. The vehicle has what we call "smart skin." It senses excessive heating and air loads and adjusts the shape of the craft for flow control and separation and load alleviation to avoid possible damage. The vehicle itself can take corrective action to change the lift and optimize performance. That's critically important while traveling at Mach 7 and at an altitude over 30 kilometers.

Back to our international crew of astronauts -- to ensure that our exploration activities were enduring and not single mission events, NASA placed an emphasis on facilities at strategic locations in the Solar System. For example, the solar Libration Point 1, is a stable location out of the Earth's gravity well that provides an excellent, nearby, viewing platform for Sun-Earth observations, astrobiological observations, and could serve as a transportation node for refueling. Similar locations throughout the Solar System will serve as nodes able to support research, communications, transportation, and in-space operations. These facilities will enable the conduct of a wider range of research, development, and exploration opportunities.

The research scientists and engineers working at these outposts are also using "smart" technology. The crew are wearing body forming "smart" suits that incorporate biosensors to record and report on various health parameters. Biological sensors are also used to report directly to the spacecraft control systems on air and water quality. A special electronic nose gives real-time reporting of any potential chemical or biological contamination that could threaten the lives of the astronauts.

Because the flight back from the outpost takes a few months, and the mission itself lasts a few years, the spacecraft used by our astronauts must be an ecosystem in its own right. It has a life-support recycling system that uses algae and other small organisms to rid the air and water of impurities and to generate oxygen.

The spacecraft also has incredible new tools and the capacity for virtual surgery. So if one of the astronauts gets sick, they won't have to worry about being so far away. The other members of the crew will simply practice in virtual space and then conduct the procedure themselves. Simply put, the spacecraft is self-sufficient.

Our crew returns safely. As soon as the official reception committee congratulates the astronauts, the Japanese Prime Minister is informed that he is needed back home for an emergency meeting. Even with a two hour flight, the Prime Minister will not be able to get to the meeting in time. However, like the heavy fog that existed when the Prime Minister arrived, this is not an insurmountable problem like it was back at the turn of the century.

The Prime Minister's seat on the vehicle becomes a virtual office. Advances in information technology and networking capacity allow for total immersion virtual presence. There is sight and sound and touch, and if you need it, even smell. The Prime Minister is briefed by his staff at home in a virtual environment. Then, while still on the vehicle, he participates in the full Cabinet meeting.

The other members of the Cabinet are projected in such clarity, it is like being there. You can't

tell the difference. It is seamless. And it is only fitting, because this same virtual technology was used to simulate the entire development life cycle of the flight vehicle before anyone cut a single piece of hardware. Geographically distributed teams were able to be linked and development progress could follow the sun, making significant cuts in development cycle time and cost. It was used to simulate the harmonics of the entire factory where the vehicle was built before pouring any concrete or putting up any walls.

This virtual technology was incorporated into the training regime for astronauts as they prepared for their mission. It also enabled millions of people on Earth to join in the adventure of exploration throughout the journey.

The significance of these strategic goals that I have proposed here is about more than sending astronauts to outposts beyond Earth orbit and bringing them back. It's about the United States and other people and other countries working together to erase the distinction between air and space travel. It's about exploring new worlds in space and creating a new world here on Earth.

Opening the space frontier cannot depend solely on incremental evolutionary changes to the systems that enabled past achievements. We must also look to bold, innovative and high risk revolutionary leaps forward. What I have described here today is less science fiction than the notion of sending a human to the Moon was back on NASA's first day of operation in 1958. Researchers at the Centers are already conducting research on each of the technologies I have just described. And as exciting as the possibilities are to imagine, the most startling developments will no doubt occur in areas we have not even thought of yet.

Surgeons at Stanford University can now do reconstructive facial surgery on a three dimensional virtual light table and show the patient what they will be doing before they start.

Next year, a reusable launch vehicle will take off from the Mojave Desert in southern California and land at Malstrom Air Force Base in Montana -- 1,000 miles in under 25 minutes. It will hit Mach 15, yet the pilot will be on the ground in a virtual cockpit.

We are working on combustion experiments at 2000 degrees Centigrade that will have a profound impact on energy usage throughout the world.

The solutions to all these technology challenges are not yet apparent. Most are high risk and require long lead times for application. But all offer opportunities for American industries to maintain a competitive advantage in the global market place and unbelievable possibilities for future generations to enjoy a future of security and prosperity.

There will always be those who will tell us why we should not attempt to achieve this vision. We have heard the arguments before: It can't be done. It's too risky. It's too expensive. NASA is too much a bureaucracy to achieve such an ambitious agenda. There are higher priorities that need to be taken care of in the near-term.

I couldn't disagree more. For the past five years, we have all been part of significant management reform and reinvention activities that will lay the foundation for new ways of doing business in the future. I know many of you have struggled with these many changes and the increased demands placed upon you. Change is never easy and it's even tougher when initiated in response to fiscal constraints and a downsized workforce.

Time and again during the past five years, the NASA Team has risen to the challenge where others may have given up. We have proven to the Administration and Congress that while we might be middle-aged, our best years are ahead, not behind us.

As difficult as it has been for us, think about what it must be like for our colleagues in Russia who are working under extremely trying circumstances. The entire nation is undergoing tremendous growing pains in all sectors of their society, yet their aerospace workforce is as dedicated to their dreams and aspirations as we are. Despite the extra burden this has placed on many of you who work closely with the Russians, I hope you will find the inner strength to see your projects through.

In the meantime, you are all familiar with the management and process reforms have been implemented. The goal of these reforms is to allow you to spend more time on the work that drew you to the Agency and less time on paperwork.

We have increased opportunities for innovative partnerships that feature the sharing of cost and risk between the government and private sector. We are investigating the best methods to transfer functions that are not inherently governmental to the private sector. We have begun to incorporate data buys from the private sector to meet our science and technology mission goals and operational requirements.

It is my hope that within ten years, NASA will have transferred all low Earth orbit operations and infrastructure to the private sector. We will then be able to focus our human and financial resources on doing the things we all really want to do -- push the frontiers of science and advance technology.

I believe that the observance of our middle-age milestone provides an excellent launch pad for superior achievements yet to come. The excitement generated during the Agency's youthful sprints of the past has made way for sustained long-term marathons in the future. We are learning from our mistakes and we are taking corrective action to improve future missions.

If we are to maintain the trust and support of the public and political establishment, we must continue to do what we say we're going to do and honor our commitments to the Administration, Congress, and the tax payers.

In the heat of the Cold War, NASA was created to demonstrate that the values and freedom of democracy was a superior means to accomplish bold and noble challenges. After four decades of achievement, there should be no doubt that NASA has succeeded in fulfilling the original expectations from the Administration and Congress. We have demonstrated capabilities and expertise that are the envy of the world and a model for other spacefaring nations.

As we enter the New Millennium and define new challenges for our aeronautics and space aspirations, I call upon all members of the NASA Team to pledge that you will ensure your contribution will return high value for the public's investment. We will continue to set challenging goals and hold ourselves to even higher standards of excellence. And many of you know me -- I'll always be looking for that last five percent improvement from each of you.

I would like to end with the words of a noted aerospace pioneer who devoted a good deal of time to the question of how humanity could benefit from the exploration and exploitation of space

resources and capabilities. Speaking to a gathering of navigation engineers in Huntsville shortly after NASA's 10th anniversary, Dr. Krafft Ehricke of North American Rockwell outlined his vision for the future.

In closing his remarks, Dr. Ehricke suggested that "Perhaps, as we place the extraterrestrial domain into the service of all people, we may be permitted to hope for the greatest benefit of all: that the ugly, the bigoted, the hateful, the cheapness of opportunism and all else that is small, narrow, contemptible and repulsive becomes more apparent and far less tolerable from the vantage point of the stars than it ever was from the perspective of the mudhole. After all, should we not take a cue from the fact that since the beginning, we have always placed our dreams and aspirations among the stars?"

We at NASA anticipate the future with great expectations. To bring the domain of space into the service of humanity. To do our part to realize the dreams and aspirations of a great nation in the decades to come.

A very happy birthday to the most outstanding organization in the world!

*******